ASTM F1166: Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities

Presentation to the 2008 DoD Standardization Program Conference
6 March 2008

Quick Document Summary

- **DoD was moving from MIL-STD's to "Commercial" specifications in the late 1980's**
- **Navy sought commercial replacements for MIL-STD's including MIL-STD-1472**
- **Navy wanted sponsorship or endorsement of new specifications by respected standards organizations**
- **ASTM F1166-88 was published in 1988**

Commercial Standard Necessity

- **HFE standards must evolve with technology**
- **MIL-STD 1472 was difficult/cumbersome to revise**
- **MIL-STD 1472 did not address maritime-specific issues adequately**
- **New HFE research became available**

Document Revisions

- **Revisions in 1995, 2000 and 2006**
- **Major revision began in the fall of 2005**
- **Feedback from ASTM F1166 users**
- **Personal experience of authors using ASTM F1166**
  - *Conducting incident and accident investigations*
  - *Consulting to shipyards, naval architects, shipping and offshore companies*

ASTM F1166 Use

- **Navy Ships and systems beginning in the early 1990’s**

- **Offshore Rigs, Platforms and Supply Boats beginning in May of 1990**

Revision Needs

- Need to improve the ease of finding a specific design criteria based upon improved organization and formatting
- Need to place tables and figures closer to referencing text
- Need to set minimum font size for text and visual aids
- Need for emphasis on design for international populations
- Need to include most recent maritime HFE research

Revision Needs

- Need to be more compliant with other current HFE design standards
- Need to address new U.S. Navy modes of operation
- Need for inclusion of a design checklist tied to ASTM
- Need for prioritization of design requirements, e.g. those that “shall”, “should” or “may” be followed
- Need for input and review of standard by HFE professionals with experience in both commercial and military sectors

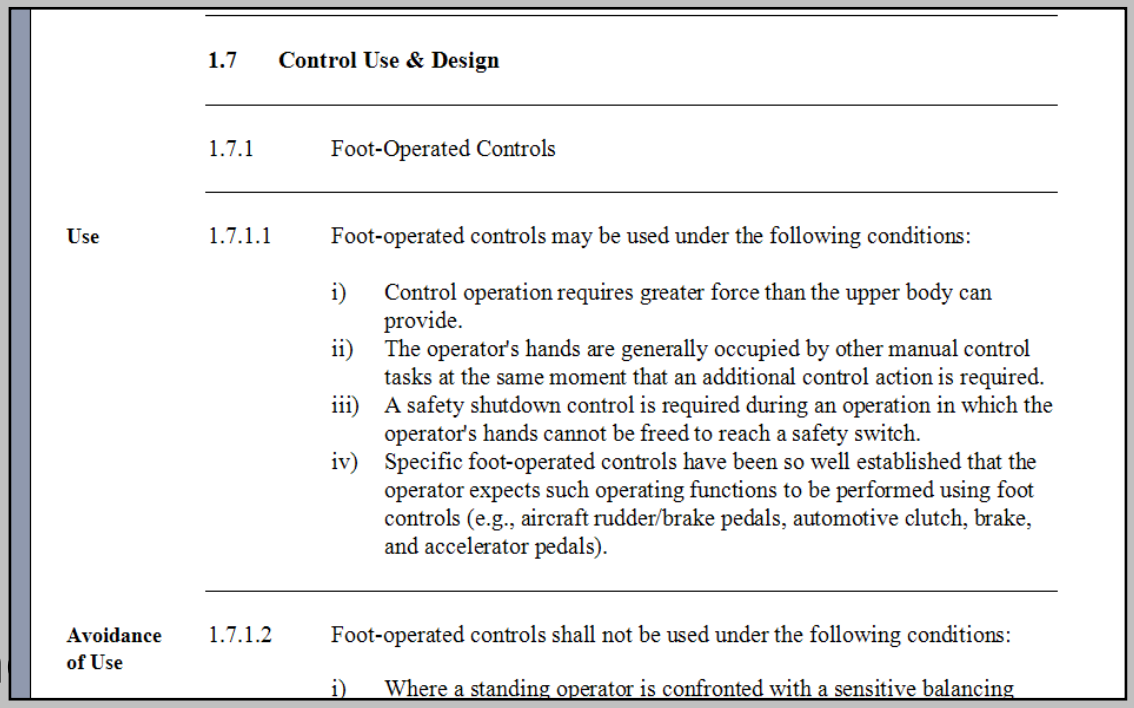
Revision Goals

- **Update the format to make the document more usable in terms of format and presentation of information**
- **Update and prioritize the technical content to meet the technical demands of current marine systems**
- **Make the revised document more compatible with other current HFE design standards**

How it looks today…

New Organization and Format

- **“Information Mapping™” Format**
  - *Improved readability, search and navigation*



	1.7 Control Use & Design	
	1.7.1	Foot-Operated Controls
Use	1.7.1.1	Foot-operated controls may be used under the following conditions: i) Control operation requires greater force than the upper body can provide. ii) The operator's hands are generally occupied by other manual control tasks at the same moment that an additional control action is required. iii) A safety shutdown control is required during an operation in which the operator's hands cannot be freed to reach a safety switch. iv) Specific foot-operated controls have been so well established that the operator expects such operating functions to be performed using foot controls (e.g., aircraft rudder/brake pedals, automotive clutch, brake, and accelerator pedals).
Avoidance of Use	1.7.1.2	Foot-operated controls shall not be used under the following conditions: i) Where a standing operator is confronted with a sensitive balancing

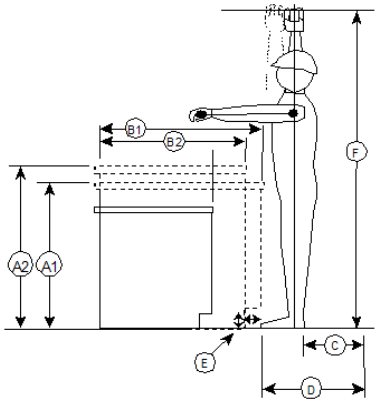
- **In**
  - *Each with its own table of contents and index*
  - *Each can be utilized as a stand-alone document*

Organization and Format

- **Master Table of Contents**
- **Greater cross-referencing of chapters**
  - *Minimal duplication of information*
- **Emphasis on placing figures and tables immediately following references in text**

Standing Work Bench Dimensions 6.9.2 Standing work bench dimensions and clearance around work benches shall be designed as shown in Figure 6-22, "Work Bench Dimensions".

Figure 6-22 Work Bench Dimensions



		Height above floor			Max Depth	
Standard bench (Standing)	**A1**	914 mm	36 in	**B1**	1016 mm	40 in
Example: Work bench in machinery shop for maintenance of valves.						
Tall Bench	**A2**	1016 mm	40 in	**B2**	914 mm	36 in
Example: Work bench for fine detail inspection or maintenance						

Organization and Format

- **HFE Design Checklist**
  - *Critical design development and verification tool*

HUMAN FACTORS CHECKLIST FOR DESIGN

		Yes	No	NA
CHAPTER 1	**CONTROLS**			
GENERAL DESIGN PRINCIPLES				
1.	Are all controls labeled per the requirements of Chapter 11? Chapter 1, paragraph 1.2.1	____	____	____
2.	Have the controls been selected to be compatible with the 5th to 95th percentile body dimensions of the full range of user population (male and female) expected on this ship? Chapter 1, paragraph 1.2.3	____	____	____
3.	Are all controls located and sized to be compatible with the clothing or personal protective equipment that could be worn by an operator (e.g., arctic mittens, fire turnout coats, NBC protective suits)? Chapter 1, paragraphs 1.2.3 and 1.2.10	____	____	____
4.	Are the most important or frequently used controls located in the most favorable position with respect to the operator's ease of reach and grasping? Chapter 1, paragraph 1.3.1 (xii)	____	____	____
5.	Does the direction of movement of the controls comply with the control movement stereotypes shown in Chapter 1, paragraph 1.4.1 (Table 1-2 and Fig 1-1)	____	____	____
TYPE OF CONTROLS				
6.	Are multi-rotational controls used when precision setting is required per Chapter 1, paragraph 1.2.5?	____	____	____

Technical Content

- **Omission of unnecessary criteria:**
  - *Technical data requirements included in the original standard found to be of no, or limited, value in the design of marine equipment*
  - *Explanatory or justification information simply supporting a particular design requirement.*
    - The goal is to ensure that the ASTM F1166 appear more like a design standard than a text book on HFE design.

Technical Content

- **New design criteria based on ship and offshore HFE design and research experience**
  - *Some requirements originate directly from the experiences of the authors, HFE reviewers and SMEs*

- **Emphasis on new design data to prevent known ship accidents and/or to provide for areas of importance in coming new ship/structure designs**
  - *New design criteria for access aids throughout vessel or structure*
  - *Maximum stair angle*
  - *Fall protection on vertical ladders*
  - *Number of levels of hazard warnings (two rather than three)*
  - *Improved HCI design criteria*

Technical Content

- **Significant effort to quantify the requirements**
  - *Minimal use of terms “as much as possible” or “minimize” or “as appropriate”*
- **Broader range of reference documents (ILO, ABS, other ASTM)**
  - *Greater use of ABS influence from the commercial sector*
- **Minimal Habitability data**
  - *Focus on ambient environment criteria (noise, vibration, lighting and climate)*

Technical Content

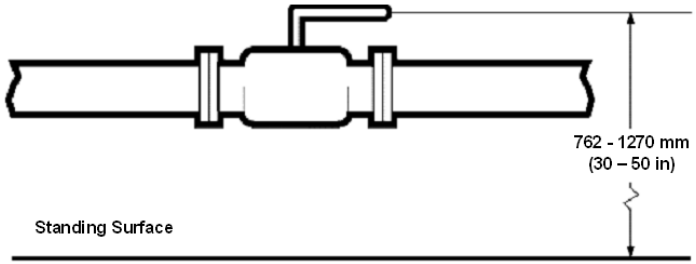
- **Greater emphasis on international users with international anthropometry data**
  - *In "Anthropometry" chapter as well as "Access Aids", "Workstation Design" and "Valve" cha*

Vertical Stem Orientation

above the standing surface as shown in Figure 8-5 "Mounting Heights for Lever-Operated Valves With Vertical Stems". (See the Note at the bottom of Figure 8-5 for the exception to these dimensions).

The handle on all vertical stem valves shall not rotate into a walkways or working areas so as to become a tripping or knee knocker hazard.

Figure 8-5 Mounting Heights for Lever-Operated Valves With Vertical Stems*

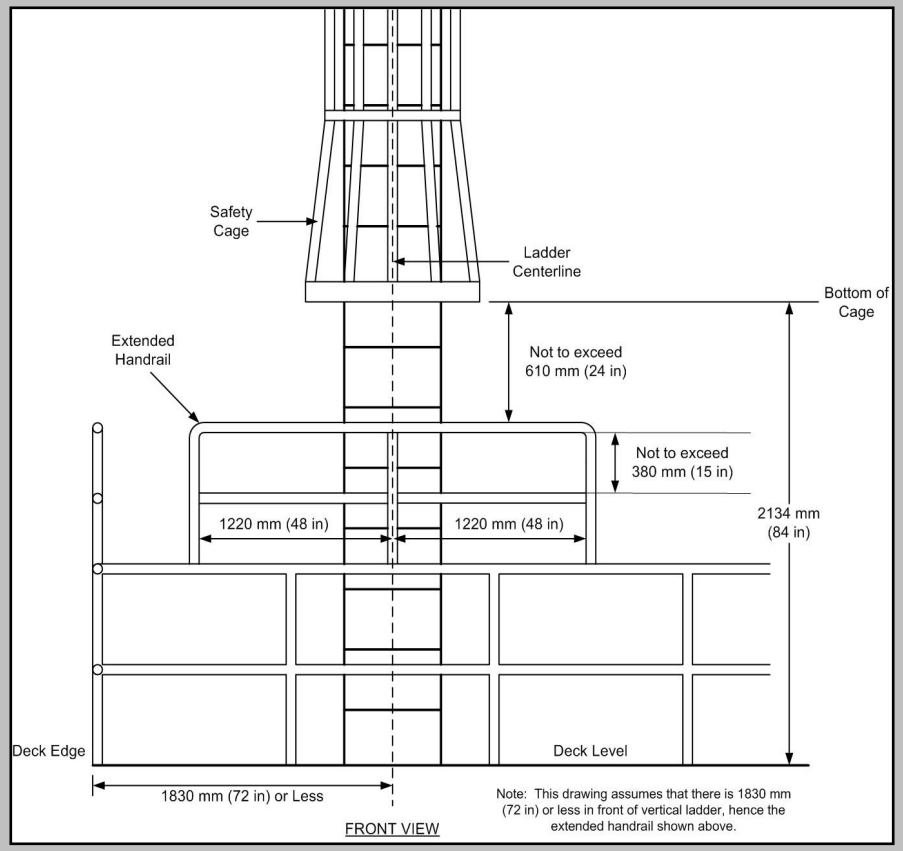


* These dimensions are appropriate for the 5th % female to the 95th % male maritime personnel worldwide except that the maximum height dimension should be reduced to 1143 mm (45 in) to accommodate 5th % females from geographic locations such as West Africa, Southeast Asia, China, parts of Latin America, India, and Japan.

Mounting 8.5.2 Valves oriented with the stem in a horizontal position are preferred when the

Technical Content

- **Increased quality and use of visual aids**
  - *Tables larger, new figures generated for unique issues*



Results

- **Vastly improved readability and usability**
- **Incorporates many years of HFE lessons learned onboard ships**
- **More robust and relevant design criteria for modern maritime industry**
- **Incorporates international requirements**
- **Better meets needs of both military and commercial industries including tie-ins with ABS Guides**
- **Inclusion of checklist makes application easier for users**
- **Overall, a far superior HFE Standard for the Maritime industry in terms of completeness, relevance and usability**
  - *e.g., Shell Oil intends to adopt this revision as their HFE standard.*

Credits

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Questions?